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ANM-111

INFORMATION Policy Concerning Substantiation of Control Surface Tabs for FAR 25.629(d) and 25.629(d)(4)(vi); ASW-210 ltr of 2-5-81

Chief, Lead Region Staff, ANW-110

Chief, Engineering and Manufacturing Branch, ASW-210

Compliance with the freedom from flutter requirements of FAR 25.629(d) for control surface tabs may be demonstrated by either a dual load path tab design or by a balanced tab with appropriate substantiation showing freedom from flutter with a single failure in the tab control system.

The dual load path method would require an assessment of residual fatigue static strength after the single failure to assure that the remaining load path would not fail before the single failure was detected. This assessment should include the establishment of a conservative inspection period and inspection method. This procedure is considered to be necessary in view of adverse service experience where both tabs have failed. FAR 25.601 provides an adequate regulatory basis to require this assessment. For those airplanes whose certification basis includes Amendment 45 to FAR 25, FAR 25.571 provides a specific regulatory basis for this assessment.

The balanced tab method of demonstrating compliance is acceptable provided the analytical technique is conservative, based on experimental data, and conducted by flutter analysts with considerable experience in tab flutter analysis. Tab flutter analyses are exceptionally complex and subject to considerable unreliability if the above provisions are not met.

Recommendations for Balanced Tab Flutter Analyses

It is essential that the steady aerodynamic hinge moments of the control surface and tab be determined from experimental data and the quasi-steady aerodynamic coefficients used in the flutter analysis be adjusted to match these experimental values at zero frequency. Although theoretical coefficients are higher and tend to reduce the critical flutter speed, they also provide a higher aerodynamic damping and consequently may suppress the typical hump modes associated with control surface and tab flutter. Both theoretical and adjusted coefficients should be used since the flutter mode could be either speed critical or damping critical. Once the analysis has been conducted with the nominal experimentally adjusted values of hinge moment coefficients, the analysis should be conducted with parametric variations of these coefficients and other parameters subject to variability.

If the above recommendation are followed and the flutter clearance is marginal in either speed or damping for any of the analysis conditions, further substantiation by test should be required.

Recommendations for Balanced Tab Flutter Tests

Either representative wind tunnel flutter model tests to V_D or flight flutter tests to the range of critical speeds shown by analysis should be conducted if the analysis is marginal. The tab failure may be

simulated by free play provided the free play is sufficient and the test can be conducted without the tab grounded at either limit. The location of the free play in the tab system should be selected with regard to the amount of tab control system that contributes to the tab balance and tab inertia so that the critical combination of these values as indicated by the analysis is represented.

MIL-A-8870A provides tab rotational free play limits below which the tab is considered irreversible. Since these are conservative limits, the free play established to simulate a free tab should be well above these limits. The tab and control surface should be rendered as friction free as possible and normal slop resulting from wear, deterioration, or manufacturing variability should be induced in the tab hinges along with the tab rotational free play.

The exact amount of tab rotational free play should be established for each specific case depending on tab and control surface geometry. It should be well above the MIL-A-8870A limit of 1.15 degrees, sufficient to assure that the tab will float free at the test speed. Five degrees have been accepted on several occasions to represent a failed tab. Lesser values could be acceptable provided adequate instrumentation were installed to determine if the tab were free floating at the test speed.

Other Single Failure Considerations

In addition to single failures in the tab control system, the failure of a tab supporting hinge should be considered under FAR 25.629(d). This failure mode can result in a large reduction in tab rotational frequency particularly when the tab rods are connected close to the failed hinge. This condition can be critical whether or not dual tab rods are used.

Signed by D.L. Riggin